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EXAMINER	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/817,471	SUN ET AL.	
	Examiner	Art Unit	
	Mia M. Thomas	2609	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-42* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20 and 22-42* is/are rejected.

7)☒ Claim(s) *21* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *01 April 2004* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *see attached*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Drawings

1. The drawings are objected to under 37 CFR 1.83(a) because they fail to show appropriate contrast, detailed images, and concepts of what is presented as applicant's invention for Figures 1-13 and 17-20. The drawings are not sufficiently described according to the invention as it is outlined in the specification. Referring to Figures 1-5 the images presented in this application do not clearly represent the compression or super resolution claimed. The overall compression and the multiple examples leading to toward the actual "compression" claimed in the invention are not clearly displayed in the applicant's drawings. It is also unclear concerning the details of the interpolation of figures 7-11 and concerning the resolution and frequency of the images present in applicant's drawings. Additionally, for figures 17-20, it is unclear as to what definition is trying to be detailed in these drawings, in the low-frequency images in addition to the contour patches, the nearest neighbor and Markov chain images. Also, referring to Figure 6, the training objects are not identifiable in accordance with the applicant's drawings. Referring to Figures 12 and 13, the filter bank and the primitives shown are not clearly illustrated in addition to the determination for boundaries and analysis of the filter bank and the primitives. Overall, Figures 1-13 and 17-20 are lacking the appropriate contrast to interpret the various objects described in the specification. Any structural detail that is essential for a proper understanding of the disclosed invention should be shown in the drawing. MPEP § 608.02(d). Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid

abandonment of the application. Any amended replacement-drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the examiner does not accept the changes, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1-12, 22-29 are rejected under 35 U.S.C. 102(b) as being anticipated by Freeman et al. (US 6,766,067 B2).

Regarding Claim 1, Freeman discloses a method of generating a high-resolution image from a generic low-resolution image (For example, see Figure 2, "As shown in FIG. 1, our invention generates a super-resolution (high resolution) pixel image 101 from an input (low resolution) pixel image 102 in a single processing pass 200..." at column 3, line 25), the method comprising: extracting a plurality of low-frequency primitives from a low-resolution image ("After some initial pre-processing, described below, each low resolution image 102 is partitioned into an array of overlapping patches of pixels centered on pixels 1-9 spaced at coordinates (X, Y) that are P pixels apart..." at column 3, line 31); and replacing one or more respective ones of the plurality of low-frequency primitives with corresponding primitives from stored training data to provide a high-frequency primitive layer of the low-resolution image ("We convert the low resolution image 102 to the high resolution image, on a patch-by-patch basis." At column 4, line 6).

Regarding Claim 2, Freeman discloses wherein the high-frequency primitive layer comprises a plurality of high-frequency primitives (For example, see Figure 2, numeral 101 and 110; "For the high resolution...a high band patch 110 overlaps adjacent patches by one pixel. For an initial doubling factor, i.e., twice the resolutions, the high band patches 110 are M x M (e.g., 5 x 5) pixels." at column 3, line 36).

Regarding Claim 3, Freeman discloses wherein the stored training data comprises a plurality of primal sketch priors (For example see Figure 2, numeral 250; As described below, we pre-structure the training database to store pairs consisting of an index vector and a corresponding high band output patch." at column 4, line 1).

Regarding Claim 4, Freeman discloses, wherein the stored training data is provided by comparing pairs of low-resolution and high-resolution versions of a same training image ("The training database 250 for our super-resolution method 200 is built from mid band and high band pairs of training patches." at column 5, line 46.)

Regarding Claim 5, Freeman discloses further comprising normalizing the plurality of low-frequency primitives prior to the replacing ("Therefore, our method normalizes the pixel intensities in the search vector 304 by a mean absolute value 310 of the mid band patch 222, across all of color (RGB) values, plus some small ε to avoid overflow." at column 5, line 35).

Regarding Claim 6, Freeman discloses applying Markov chain inference to the high-frequency primitive layer to provide contour smoothness ("Therefore, spatial consistency between high band patch selections at adjacent patch locations is taken into account by a Markov network." at column 2, line 42).

Regarding Claim 7, Freeman discloses interpolating the low-resolution image to provide a low-frequency image prior to the extracting ("The images are first partitioned into respective overlapping interpolated low resolution patches and corresponding high resolution patches. The interpolated low resolution patches are then processed in a raster scan order." at column 2, line 66).

Regarding Claim 8, Freeman discloses, a method as recited in claim 1, further comprising bicubically interpolating the low-resolution image to provide a low-frequency image prior to the extracting ("The low resolution images are first scaled up by a factor of two in each dimension by some conventional interpolation means, such as bilinear

interpolation or bicubic spline interpolation, to form the interpolated low resolution image." at column 2, line 15).

Regarding Claim 9, Freeman discloses a method as recited in claim 1, further comparing: interpolating the low-resolution image to provide a low-frequency image prior to the extracting; and combining the high-frequency primitive layer with the low-frequency image to provide an intermediate image ("For each interpolated low-resolution patch, a mid band input patch is generated. A search vector is constructed from pixels in the mid band input patch, and pixels in an overlap region of adjacent previously predicted high band patches." at column 3, line 4).

Regarding Claim 10, Freeman discloses interpolating the low-resolution image to provide a low-frequency image prior to the extracting; combining the high-frequency primitive layer with the low-frequency image to provide an intermediate image; and reconstructing the intermediate image to provide a high-resolution image ("A nearest index vector to the search vector is located in a training database, and the nearest index vector has an associated high band output patch. The high band output patch is then combined with the interpolated low frequency patch to predict pixel values for the corresponding high resolution patch of the super-resolution image." at column 3, line 8).

Regarding Claim 11, Freeman discloses interpolating the low-resolution image to provide a low-frequency image prior to the extracting ("The interpolated low resolution images are high-pass filtered, removing the lowest spatial frequency components, to obtain the mid band images. The interpolated low-resolution images are also subtracted from the corresponding high resolution images, to obtain the high band

images." at column 2, line 20); combining the high-frequency primitive layer with the low-frequency image to provide an intermediate image; and reconstructing the intermediate image by applying backprojection to provide a high-resolution image ("The high band image is then added to the interpolated low resolution image to form the high resolution estimated image, which is the output of the super-resolution algorithm." at column 2, line 34).

Regarding Claim 12, Freeman implies that the method of claim 1 can be implemented on one or more computer readable media storing computer executable instructions that, when executed, perform the method as recited in claim 1 at column 1, line 29; "In addition, many other applications in graphics or image processing can benefit from resolution independent image processing, such as texture mapping, consumer photographs, target identification, and converting small screen, analog video to large screen, HDTV data").

Regarding Claim 22, considering that Freeman teaches the method of claim 1, which resembles equally the computer readable media claimed in this claim, it is implied that Freeman uses one or more computer readable media to implement the method claim steps of claim 1. It is also implied that Freeman uses a computer to implement these steps based on the fact that Freeman presented these similar method steps at the IEEE Computer Society Proceedings in 2000.

Claim 23 resembles equally the method steps of claim 5. Claim 23 is rejected for the same reasoning's as presented in claim 22.

Claim 24 resembles equally the method steps of claim 6. Claim 24 is rejected for the same reasoning's as presented in Claim 22.

Claim 25 resembles equally the method steps of claim 7. Claim 25 is rejected for the same reasoning's as presented in claim 22.

Claim 26 resembles equally the method steps of claim 8. Claim 26 is rejected for the same reasoning's as presented in Claim 22.

Claim 27 resembles equally the method of claim 9. Claim 27 is rejected for the same reasoning's as presented in Claim 22.

Claim 28 resembles equally the method of claim 10. Claim 28 is rejected for the same reasoning's as presented in Claim 22.

Claim 29 resembles equally the method of claim 11. Claim 29 is rejected for the same reasoning's as presented in Claim 22.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 13-15 and 30, 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Freeman et al. (US 6,766,067 B2) in combination with Guo ("<u>Towards a Mathematical Theory of Primal Sketch and Sketch-ability</u>", hereinafter referred to as Guo (MTPS).

Regarding Claim 13, Freeman '067 discloses extracting a plurality of low-frequency primitives from a low-resolution image and replacing one or more respective ones of the plurality of low-frequency primitives with corresponding primitives from stored training data to provide a high-frequency primitive layer of the low-resolution image at column 3, line 31)

Freeman '067 does not disclose extracting, at a training phase, a plurality of primal sketch priors from training data and utilizing, at a synthesis phase, the plurality of primal sketch priors to improve a low-resolution image by replacing one or more low-frequency primitives extracted from the low-resolution image with corresponding ones of the plurality of primal sketch priors.

Guo (MTPS) teaches extracting, at a training phase, a plurality of primal sketch priors from training data ("It represents images by elements selected from a dictionary of image bases (primitives or token) [10] like wavelets [3], ridgelets [1] etc.; Refer to Figure 2(e)-Collection of primitives or textons and Figure 2(b)-Primal sketch with each element represented by a bar or circle." at page 1, right column, paragraph 1); and utilizing, at a synthesis phase, the plurality of primal sketch priors to improve a low-resolution image by replacing one or more low-frequency primitives extracted from the low-resolution image with corresponding ones of the plurality of primal sketch priors (Refer to figure 2(d)-Synthesized image with non-sketchable pixels filled in by texture using sketchable pixels as boundary conditions. Figure 2(e)-Collection of primitives or textons. "Each element is represented by a primitive selected from a dictionary (Figure 2(e)." at page 2, left column, paragraph 4).

At the time the invention was made, it would have been obvious to one of ordinary skill in the art to facilitate an extraction of a plurality of primal sketches at a training phase and also adding at a synthesis phase, utilizing the plurality of primal sketch priors as taught by Guo to the method of extracting a plurality of low-frequency primitives from a low-resolution image and replacing one or more respective ones of the plurality of low-frequency primitives with corresponding primitives from stored training data to provide a high-frequency primitive layer of the low-resolution image as taught by Freeman '067 because the extraction of primal sketches at a training phase and utilization of the primal sketches at a synthesis phase allows the synthesis of the primal sketches to have "...a realistic looking texture and edges by using a larger library of local image data generated by the training phase and the synthesis phase." (Freeman '067, column 2, line 5).

Regarding Claim 30, considering that the method steps of claim 13 are the computer readable medium steps of claim 30, these steps are implemented as a computer science and mathematical theory application, a computer readable media with instructions stored thereon can direct a machine to perform the steps of the method. Guo et al. discloses these method steps at a conference on Computer Vision Proceeding of the IEEE International Conference for Computer Science. It is implied that the application of these respective method steps can be implemented in one of more computer readable media.

Regarding Claim 14, Guo (MTPS) teaches wherein the training data is provided by comparing pairs of low-resolution and high-resolution versions of a same training image

(" Each element is represented by a primitive selected from a dictionary (Figure 2(e)." at page 2, left column, paragraph 3; Referring to Figure 2(e), row 1 (see printouts), images 1-5 are low-resolution pairs and row 4 (see printouts), images 16-20 are high resolutions pairs.)

Regarding Claim 15, Freeman '067 discloses applying Markov chain inference to the high-frequency primitive layer to provide contour smoothness at column 2, line 42. Freeman '067 does not expressly disclose applying Markov chain inference in the synthesis phase to provide contour smoothness.

Guo (MTPS) teaches applying Markov chain inference in the synthesis phase to provide contour smoothness ("We first conduct a theoretical study of the descriptive Markov random field model and the generative wavelet/sparse coding model from the perspective of entropy and complexity. The competition between the two types of models defines the concept of sketchability, which divides images into texture and geometry." at page 1, left column, paragraph 1, abstract).

At the time the invention was made, it would have been obvious to one of ordinary skill in the art to execute an application of the Markov chain inference in the synthesis phase to provide contour smoothness as taught by Guo to the application of the Markov chain inference to the high-frequency primitive layer to provide contour smoothness as taught by Freeman because the user will be able to define more

comprehensive portions of the images texture and geometry. "We want to combine the two themes of scene estimation and statistical learning." (Freeman)

Claim 31 resembles equally the method steps of claim 15. Claim 31 is rejected for the same reasoning's as presented in Claim 30.

6. Claims 16-20, 35-42 rejected under 35 U.S.C. 103(a) as being unpatentable over Freeman et al. (US 6,766,067 B2) in combination with Freeman ("<u>Learning Low-Level Vision</u>"), hereinafter referred to as Freeman (LLLV).

Regarding Claim 16, Freeman '067 discloses interpolating a plurality of low-frequency primitives from a low-resolution image, combining the high-frequency primitive layer with the low-frequency image to provide an intermediate image; and reconstructing the intermediate image to provide a high-resolution image at column 3, line 8.

Freeman '067 does not disclose hallucinating a low frequency image ($I^{L}{}_{H}$); extracting a high-frequency primitive layer ($I^{P^*}{}_{H}$) of the hallucinated low-frequency image.

Freeman (LLLV) teaches, hallucinating a low-frequency image ($I^{L}{}_{H}$) ("...the VISTA approach learns the relationship between the blurred images..." at page 31, right column, paragraph 2); extracting a high-frequency primitive layer ($I^{P^*}{}_{H}$) of the hallucinated low-frequency image ("For the super-resolution, the input image is a low-resolution image. The scene to be estimated is the high resolution version of the same image." at page 31, left column, paragraph 6); combining the low-frequency image ($I^{L}{}_{H}$) and the high-frequency primitive layer ($I^{P^*}{}_{H}$) to provide an intermediate image ($I^{G}{}_{H}$) ("However, we can visually identify edges in the low-resolution image that we know

should remain sharp at the next resolution level." At page 31, right column, paragraph 2); and reconstructing the intermediate image (I^{G}_{H}) to provide a high-resolution image (I_{H}) ("The scene to be estimated is the high frequency detail removed by that process from the original sharp image, refer to Figures 7(a) and (b) at page 31, right column, paragraph 3).

At the time the invention was made, it would have been obvious to one of ordinary skill in the art to execute the step of hallucinating a low-frequency image (I^{L}_{H}) and extracting a high-frequency primitive layer ($I^{p^*}_{H}$) of the hallucinated low-frequency image as taught by Freeman (LLLV) to the method of extracting a plurality of low-frequency primitives from a low-resolution image, combining the high-frequency primitive layer with the low-frequency image to provide an intermediate image; and reconstructing the intermediate image to provide a high-resolution image as taught by Freeman '067 because it is more efficient for the user to be careful not to "ignore important spatial consistency constraints. " (Freeman LLLV). The hallucinated image is also referred to as the blurred and down sampled image, which allows the user to interpret the method for the low-level vision problems associated with the image.

Regarding Claim 17, Freeman '067 discloses interpolating the low-resolution image to provide a low-frequency image prior to the extracting at column 3, line 4.
Freeman '067 does not expressly disclose interpolating a low-resolution image (I_{L}) to provide the low frequency image (I^{L}_{H}).

Freeman (LLLV) teaches, further comprising interpolating a low resolution image (I_L) ("We linearly interpolate each blurred image back up to the original sampling resolution, to form an input image." at page 31, right column, paragraph 3); to provide the low frequency image ($I^L{}_H$). ("Then we remove the low-frequencies from the interpolated image, taking advantage of the assumption of Eq. (24), that the lowest image frequencies do not help predict the highest image frequencies, given the mid-band frequencies". at page 46, left column, paragraph 1; also refer to Figure 7(a) - 7(d)).

At the time the invention was made, it would have been obvious to one of ordinary skill in the art to facilitate the interpolating of a low resolution image (I_L) to provide the low frequency image ($I^L{}_H$) as taught by Freeman (LLLV) to the interpolating the low-resolution image to provide a low-frequency image prior to the extracting as disclosed by Freeman '067 because the VISTA approach as taught by Freeman (LLLV) learns the relationships between the low resolution for the training samples and prior to the extraction the training database will achieve better results.

Regarding Claim 18, Freeman '067 discloses bicubically interpolating the low-resolution image to provide a low-frequency image prior to the extracting at column 2, line 15.

Freeman '067 does not expressly disclose bicubically interpolating the low-resolution image (I_L) to provide the low-frequency image ($I^L{}_H$)

Freeman (LLLV) teaches, bicubically interpolating the low resolution image (I_L) to provide the low-frequency image ($I^L{}_H$) (Bockaert teaches that bicubic interpolation is more sophisticated than bilinear interpolation. As described, a new pixel is a bicubic function using 16 pixels in the nearest 4 x 4 neighborhood of the pixel in the original image. This is a method most commonly used in image editing software...Adobe Photoshop CS offers two variants of the bicubic interpolation method: bicubic smoother and bicubic sharper", at page 2 of 3, paragraph 1. Now, refer to Eq. (30), Freeman (LLLV); "To compute the compatibilities between neighborhooding patched at different scales, we first interpolate the lower-resolution patch by a factor of 2 in each dimension so that it had the same sampling rate as the high resolution patch." at page 40, right column, paragraph 2).

At the time the invention was made, it would have been obvious to one of ordinary skill in the art to execute bicubically interpolating the low-resolution image (I_L) to provide the low-frequency image ($I^L{}_H$) as taught by Freeman (LLLV) with bicubically interpolating the low-resolution image to provide a low-frequency image prior to the extracting as taught by Freeman '067 because prior to the extraction the interpolated low-resolution images would create a larger library of reference images for the user.

Regarding Claim 19, Freeman '067 discloses wherein the high-frequency primitive layer comprises a plurality of high-frequency primitives at column 3, line 36. Freeman '067 does not disclose the high-frequency primitive layer ($I^{P^*}{}_H$) is provided as follows: ($I^{P^*}{}_H$) =arg max p ($I^{P^*}{}_H$ $I^L{}_H$) =arg max p($I^L{}_H$ $I^P{}_H$))p($I^P{}_H$).

Freeman (LLLV) teaches wherein the high-frequency primitive layer ($I^{p^*}_H$) is provided as follows: ($I^{p^*}_H$) =arg max p ($I^{p^*}_H$ | I^L_H) =arg max p(I^L_H | I^P_H))p(I^P_H) (Now refer to Equations (1)-(6); Freeman teaches that "...the MAP and MMSE estimates" can be employed from the derivation of equations 1-6. " Each line of Eq. (6) is a local computation involving only one node and its neighbors." at page 27, left column, paragraph 3).

At the time the invention was made, it would have been obvious to one of ordinary skill in the art to determine that the high frequency primitive layer as represented by ($I^{p^*}_H$) =arg max p ($I^{p^*}_H$ | I^L_H) =arg max p(I^L_H | I^P_H))p(I^P_H) is relevant because the definition of the high frequency primitive representation allows the user to determine that by solving a Markov network, it involves a learning phase, where the parameters of the network connections are learned from training data where the high frequency primitives are stored. (Freeman (LLLV), page 27, left column, paragraph 1).

Regarding Claim 20, Freeman (LLLV) teaches, wherein the reconstructing applies backprojection to the intermediate image (I^g_H) to provide the high-resolution image (I_H); (Figures 7(a)-7(d) describes the reconstruction of what is considered to be an intermediate image, (Figure 7(c)), and thus providing the image (Figure 7(d) with high resolution. At page 8, first paragraph beneath Figures 7(a-d)).

Regarding Claim 35, Freeman (LLLV) teaches, an apparatus comprising ("We call our approach VISTA, Vision by Image/Scene Training. It is a general machinery that may apply to various vision problems." at page 26, left column, paragraph 4): means for extracting a plurality of low-frequency primitives from a low-resolution image (In contrast, the VISTA approach learns the relationship between sharp and blurred images

from training samples, and achieves better results." At page 31, right column, paragraph 2); and means for replacing one or more respective ones of the plurality of low-frequency primitives with corresponding primitives from stored training data for providing a high-frequency primitive layer of the low-resolution image ("We apply VISTA to this problem as follows. By blurring and down sampling sharp images, we construct a training set of sharp and blurred image pairs. The scene to be estimated is the high frequency details removed by that process from the original sharp image, Figures 7(a) and (b)." at page 31, right column, paragraph 3).

Regarding Claim 36, Freeman (LLLV) teaches, means for normalizing the plurality of low-frequency primitives prior to the replacing (Referring to Figures 7(a)-7(d); "Two image processing steps are taken for efficiency: the low frequencies of (a) are removed to form the input band-passed "image". We contrast normalize the image and scene by the local contrast of the input band-passed image yielding (c) and (d)." at page 32, top paragraph beneath the images representing Figure 7).

Regarding Claim 37, Freeman (LLLV) teaches, means for applying Markov chain inference to the high-frequency primitive layer to provide contour smoothness (Referring to Figure 10(c); "figure 10 shows the result of applying this super resolution method recursively to zoom two octaves. The algorithm keeps edges sharp and invents plausible textures." at page 33, right column, paragraph 2).

Regarding Claim 38, Freeman (LLLV) teaches, means for interpolating the low-resolution image to provide a low-frequency image prior to the extracting ("We apply VISTA to this problem as follows. We linearly interpolate each blurred image back up to

the original sampling resolution to form the input image…the input image is a low-resolution image." at page 31, right column, paragraph 3).

Regarding Claim 39, Freeman (LLLV) teaches, means for bicubically interpolating the low-resolution image to provide a low-frequency image prior to the extracting (Referring to Figure 16(f), a cubic spline interpolation is performed in Adobe Photoshop. Figure 16(d) and 16(g) are performed by the "VISTA" Markov network belief propagation approach, using the "generic" training set depicted in Figure 12 and the patch –overlap method of computing the compatibility matrices between nodes." at page 39, first paragraph beneath Figure 16(a)-(g)).

Regarding Claim 40, Freeman (LLLV) teaches, means for: interpolating the low-resolution image to provide a low-frequency image prior to the extracting; and combining the high-frequency primitive layer with the low-frequency image to provide an intermediate image (Referring to Figure 7, The original image, (b) is blurred, sub-sampled, then interpolated back up to the original sampling rate to form (a). The missing high frequency details, (b) minus (a), is the "scene" to be estimated, (d)." at page 32, first paragraph beneath Figures 7(a)-(d)).

Regarding Claim 41, Freeman (LLLV) teaches, means for: interpolating the low-resolution image to provide a low-frequency image prior to the extracting; combining the high-frequency primitive layer with the low-frequency image to provide an intermediate image; and reconstructing the intermediate image to provide a high-resolution image (Referring to Figure 7, The original image, (b) is blurred, sub-sampled, then interpolated back up to the original sampling rate to form (a). The missing high frequency details, (b)

minus (a), is the "scene" to be estimated, (d)." at page 32, first paragraph beneath Figures 7(a)-(d)) Another example of the intermediate image can be found at Figure 11(c), while Figure 11(g) is the result of using the training set with the Markov network super resolution algorithm at page 33, right column, paragraph 3).

Regarding Claim 42, Freeman (LLLV) teaches, means for: interpolating the low-resolution image to provide a low-frequency image prior to the extracting; combining the high-frequency primitive layer with the low-frequency image to provide an intermediate image; and reconstructing the intermediate image by applying back projection to provide a high-resolution image (Now referring to the rejection from claims 40 and 41, the above stated rejection is the same as in claims 40 and 41 and while the final limitation is perceived to be Figure 7(d). Another example of reconstructing the intermediate image by applying back projection to provide a high resolution image can be found at page 33, right column, paragraph 3, "Figure 11 explores the algorithm...and Figure 11(a) is the actual high resolution image.").

7. Claims 32-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Freeman et al. (US 6,766,067 B2) in combination with Freeman et al. (US 6,263,103 B1), hereinafter will be referred to as Freeman ('103).

Regarding Claim 32, Freeman '067 discloses the stored training data comprises a plurality of primal sketch priors at column 4, line 1.

Freeman '067 does not disclose a primal sketch priors extraction module to extract a plurality of primal sketch priors from training data and an image hallucination module to

utilize the plurality of primal sketch priors to improve a low-resolution image by replacing one or more low-frequency primitives extracted from the low-resolution image with corresponding ones of the plurality of primal sketch priors.

Freeman '103 teaches a system (See Figure 1) comprising: a primal sketch priors extraction module to extract a plurality of primal sketch priors from training data ("The invention uses statistical properties gathered from labeled training data to form "best-guess" estimates or optimal interpretations of underlying scenes." at column 1, line 54); and an image hallucination module to utilize the plurality of primal sketch priors to improve a low-resolution image by replacing one or more low-frequency primitives extracted from the low-resolution image with corresponding ones of the plurality of primal sketch priors (See Figure 1, numeral 160; "In one application of our invention, it is possible to estimate high-resolution details from a blurred, or lower-resolution image." at column 2, line 32).

At the time the invention was made, it would have been obvious to one of ordinary skill in the art to add an extraction module to extract a plurality of primal sketch priors as taught by Freeman'103 to the method step of storing training data comprising a plurality of primal sketch priors as taught by Freeman'067 because the extraction module would enable the method step of storing the training data to be performed.

Regarding Claim 33, Freeman '103 teaches wherein the training data is provided by comparing pairs of low-resolution and high-resolution versions of a same training image ("Accordingly, training data for typical images and scenes are synthetically

generated...for example, estimating high-resolution scene detail from a low-resolution version of the image, and estimating the shape of an object from a line drawing." at column 2, line 58).

Regarding Claim 34, Freeman '067 discloses applying Markov chain inference to the high-frequency primitive layer to provide contour smoothness at column 2, line 42. Freeman '067 does not disclose a Markov chain inference module to provide contour smoothness.

Freeman '103 teaches a Markov chain inference module to provide contour smoothness (See Figure 1, numeral 150; "These connections assist in removing spatial artifacts while estimating scenes. The connected Markov network 200 allows each scene node to update its belief based on accumulated local evidence gathered from other nodes." at column 4, line 40).

At the time the invention was made, it would have been obvious to one of ordinary skill in the art to add a Markov chain inference module to provide contour smoothness as taught by Freeman '103 to the application of the Markov chain inference to provide the high-frequency primitive layer to provide the contour smoothness as taught by Freeman '067 because the inference module taught by Freeman '103 allows the method of applying the Markov chain inference to be implemented.

Allowable Subject Matter

8. Claim 21 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

9. The prior art made of record in the Form 892-Notice of Reference Cited documented herein are relied upon is considered pertinent to applicant's disclosure. See attached form for a detailed account of these references.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mia M. Thomas whose telephone number is 571-270-1583. The examiner can normally be reached on Monday-Friday 8:30am-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Brian Werner can be reached on 571-272-7401. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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